An Economic Comparison of Forage Harvesting, Storage & Feeding Systems for Ohio Sheepmen 1/

The more business oriented the livestock farmer becomes the more he is thinking not in terms of bits and pieces but the whole, integrated, practical, efficient automated farm-feeding system. This is one of the reasons the profitability of farming today is influenced greatly by the decisions made with respect to the machinery, equipment and building programs. With the many types and sizes of buildings, machines and equipment available for the forage program, it would be very difficult to consider all of the alternatives. This paper is intended to provide guidelines to follow ard a brief comparison of the current forage systems.

Two of the re l stumbling blocks for higher profits in farming is

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1/ Prepared by John E. Moore, Extension Economics, Farm Management, The Ohio State University for the 1972 Ohio Sheep Day Program, O.A.R.D.C., Wooster, Ohio.

over-mechanization and over building for the amount of use available. The big dilemma is in the game of substituting capital for labor. If you don't adequately mechanize "your low labor productivity cuts your profits," and if you over mechanize "overhead costs cuts your profits." The common question is "How Big" is most economical? Generally speaking, when a modern set of farm machinery and equipment is fully used most of the economies of size have been exhausted. This is assuming you are gaining control of this use by owning the assets. We all know of farmers that have expanded and invested in a second set of equipment but found he didn't expand enough to fully use the second set and ended up disappointed with the amount of profit generated.

High Output Per Man

The key resource or the limiting resource on our farms is labor. Labor on Ohio farms has many alternative uses, both on the farm and off the farm in nonfarm jobs. The reason we have so many empty barns in Ohio is because the available labor is more productively employed elsewhere. The challenge is to up-date our technology and buildings; so our available labor can be more productively employed. To be sure the price of your product is very important to profit. In the long run the average price you receive for your product equals the average cost of production; so if you plan to cover all costs of production plus a little profit, you must strive to have a lower cost of production than the average producer in the long run. As an individual producer you need to continually analyze your costs including a cost for your own labor. Farm management studies have found that the production factor that most often correlates with high farm net income is productivity per man. Output per man is a more important profit factor than any other size factor. We don't want to confuse being busy with being productive, nor should we confuse our size standard with the man who is farming a half township. There is nothing worse than being big and bad. Be sure you get better before you get bigger. If your ewes are not lambing over 120% lambs to market then increasing the numbers of ewes won't help profit much generally. Note budget on page 24. Output per man becomes even more important if you have to cover all costs (fixed and variable or cash costs). Your costs may be different than those in this budget, but it will give you an idea of why some farmers stay in the business.

Management -- Take Time To Think

Part of the management job is to use the pencil in keeping complete and accurate records, and in budgeting and analyzing alternative investments before you buy.

Set goals to strive toward. As the old saying goes, "No wind is favorable if you know not for what port you are bound."

Keep production and financial records. Have your financial records computer analyzed once each year through your County Agent's office by the Agricultural Economics Department, The Ohio State University.

Be objective when making your business decisions. One's emotions should not overshadow one's economics.

General Guidelines

Forage is the major input in the sheep enterprise, accounting for over 80% of the feed costs. The best forage system for a particular farm would depend on many factors, including acreage, quality of land, capital available, labor supply, present machinery and feeding facilities, and most important the operator's ability.

I. Plan Before You Invest

Budget your cost of ownership of machinery, buildings and equipment before you buy to determine the annual ownership costs.

II. Keep Machinery Cost Low

Consider other control techniques to gain the use of machinery assets other than ownership. Minimize the different kinds of crops in order to minimize the types of machinery necessary to prevent high overhead costs.

III. Plan With Labor Requirements In Mind

Labor requirements throughout the year need to be considered when planning the livestock breeding and cropping programs. It is very difficult to plan a complete sheep program that will distribute evenly labor requirements over the year; so most likely another livestock program or a non-farm job must be used to supplement the income to accomplish the standard of living you desire.

Expand your labor productivity by unhitching from the high labor methods of feeding sheep. Revamp hay racks so hay can be fed twice a week instead of twice a day. Consider self-feeding concentrates whenever possible using the results of research to make this work.

Plan your hay storage so there is the minimum of labor needed to feed the forage. Consider the silage route if you have a silo and silage equipment available, however very few sheepmen can afford to invest in a silage program specifically for sheep.

IV. Be On Time

Timeliness of operation is important with the sheep enterprise and just as important in the forage program. Plan to harvest the excess growth of forage in May and early June, in order to maximize the quality and volume of total digestible nutrients from your available crop acres.

Let us go into more detail on the general guidelines listed above.

I. Plan Before You Invest

An important factor which should be considered before investing in any forage system is to analyze what the available borrowed or equity capital would earn if invested in another part of the farm business. For example, in more and better ewes, in lime and fertilizer, some good sows to supplement the sheep program, etc.

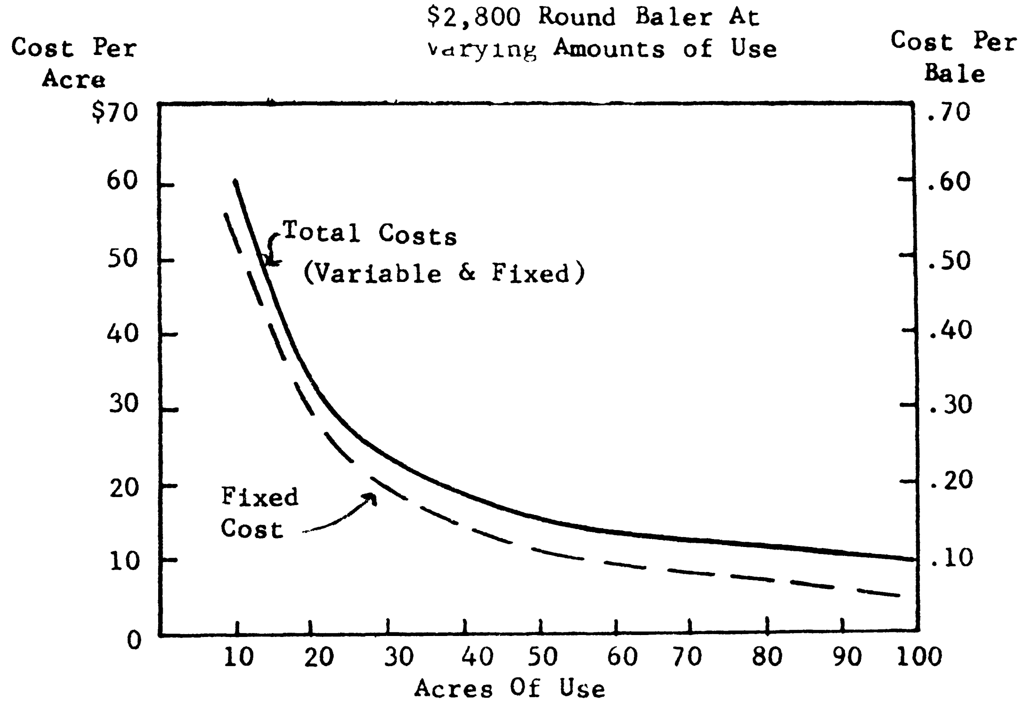
Regardless of the type of forage program you plan, spend time pushing the pencil following a system of budgeting that helps you compare alternatives. If your projected plan won't make money on paper it surely won't be profitable once you are committed to the investment. Costs in forage systems can be divided into two categories. (1) Variable or Operating Costs - These costs are proportional to the amount the asset is in use per year and includes repairs, electricity, fuel, oil, operator labor, etc. (2) Fixed or Overhead Costs - These costs decrease per unit by increased use. There are only two ways to minimize fixed costs, namely a) adequate amount of use if you do invest, or b) never commit yourself to them (don't buy) and consider other ways to gain control of this machinery use. The fixed costs include depreciation, interest, repairs, taxes, and insurance, plus shelter in case of machinery. These costs are known as the DIRTI-5 to many farm managers. Note page 25 for the percentages to use in figuring your annual costs for machinery, equipment, and building investments. These figures are based on new purchases, if you are buying second-hand assets the original cost or initial investment would be lower, but the annual cost percentage would be higher particularly as far as depreciation and repair allocation are concerned. Instead of your total annual fixed cost percentage being 20% as noted on page 25 the total annual fixed cost on a second-hand tractor with five years life left would be over 35%.

Interest charges were computed by multiplying the interest rate times the average investment or one-half of the interest rate times the full investment. Repairs and insurance is allocated as 2½% and .2%. In your particular case you may have reason to vary these coefficients some.

The next step is to take the budget sheet outlined on page 26 or a clear sheet of paper and list on the left-hand side of the sheet the increased expenses and reduced income as a result of the new investment. On the right-hand side list the added income and reduced expenses as result of the new investment; if the answer is on the positive side the investment is a possibility to consider.

Let us take an added investment in a round baler of $2,800 with a planned life of eight years. Note page 25 , 20% is the annual cost percent or the DIRTI-5. $2,800 x 20% = $560 = annual fixed cost. Divide $560 by acreage to be baled and you have the fixed cost per acre or divide by number of bales and you have the fixed cost per bale. Assume your hay is yielding 3 tons per acre of 60 pound bales or 100 bales per acre. If you baled 10 acres you would have a fixed cost on the baler alone of $56 per acre or 56¢ per bale whereas, if you had 100 acres your fixed cost would be $5.60 per acre or 5.6¢ per bale. You have variable costs of labor, lubrication, fuel for tractor and some prorated fixed cost for the tractor amounting to assume $4 per acre or total cost of $60 per acre ($56 + $4) for 10 acres. Then your costs could be charted as follows:

Illustration 1. Fixed and Total Costs For $2,800 Round Baler At Varying Amounts of Use



As the illustration above shows and as the example budget on page 26 shows, you would need over 50 acres at 100 bales per acre before you could justify a new round baler, considering the fixed and variable costs as we have assumed them to be in this example. This is also assuming that you could have a neighbor custom bale for you for 15¢ per bale.

According to Joe Blickle, Extension Agricultural Engineer, at The Ohio State University, pole barn construction for hay storage can be built for an initial investment of $15 per ton of hay storage. This does not include a concrete floor. A piece of plastic could be spread out to stack the bales on, however $20 per ton would cover storage and concrete floor. Using the fixed cost percentage to cover the DIRTI-5 as listed on page 25 your annual cost per ton of storage would be $2.40 per ton (16% times $15) for hay as compared to silage costs outlined on page 29. You must realize it takes three tons of silage storage to equal one ton of dry hay storage. Cost of storing silage per ton does not decrease much after you get over

800 tons. The labor saving aspects are very inviting at this volume of use. This same budgeting technique can be used to analyze annual costs on other new investments in machinery, equipment and buildings.

II. Low Cost Machinery Control Technique

Owning all the machinery may result in higher fixed costs than necessary and can produce debt and cash flow problems that might be reduced by considering other methods of gaining control of some items of machinery. Regardless of the method, jobs must be performed on time or it could be costly in terms of reduced yields and profits. The objective is to gain control of the use of modern machinery, but not necessarily by the ownership route alone.

Following are a few methods of gaining control:

- Buy new machinery
- Buy used machinery
- Own machinery jointly
- Exchange machinery use with neighbor
- Hire custom operators
- Lease or renting machinery
- Do custom work yourself to "Spread Overhead Costs".

The first step is to know what it would cost to own the machine per acre, per bale, or per ton, then compare this cost with other methods of getting the job done. The time is here when some good livestock men will custom hire much of their crop work done instead of replace machinery as it wears out. Instead they will expand their livestock program to intensify the use of their labor and buildings. Knowing your actual cost of ownership will:

1. Encourage you to be more willing to help pay a little above the customary custom rate to help insure timeliness and a good job on the part of the custom operator and still have more net income.

2. Encourage you to consider exchange machinery use with neighbors, or jointly own (partial partnerships), or extend your use of your own machine by doing custom work.

Leasing or renting machinery may be a possibility in a few communities. Leasing is thought of as a longer contract time than renting. Ownership annual costs might run 20%+ of the new cost while leasing would run 25-30% annually on a three year basis. The economics of both methods of control depend on adequate use. The main advantage of leasing over ownership is the smaller amount of annual capital committed.

III. Plan With Labor Requirements In Mind

Most farm labor is either family or full-time (annually) hired labor. This means it is a fixed cost in most cases and if it cannot be evenly used throughout the year you will have to hire extra labor some periods and other months will have idle time. Labor saving automation has to be paid for by either expanding the volume of products produced or laying off hired help, or by freeing time so one family member or more can work in a nonfarm job.

An all-out effort needs to be made to change from the higher labor methods, for example, from feeding twice per day to feeding larger quantities when you feed and minimize the feeding times. Store hay near feeding area and build feeders that will hold more than a day's feeding. Research at O.A.R.D.C. reports results as good on feeding twice a week as twice per day with the ewe flock

If silage facilities are available and are not fully utilized by other livestock this system of feeding generally is a low labor route plus maximizes total T.D.N. (Total Digestible Nutrients) per acre of crop from field to livestock. Labor requirements for the different forage systems will be referred to later in this paper.

IV. Be On Time

Making out a plan is one thing, but following it may take more dedication and conviction. The importance of getting the forage cut on time from an economic standpoint cannot be over emphasized. Volume of T.D.N. in the livestock's stomachs is what you are after not a mow full of late June hay that is of low palatability and digestibility. This takes some real doing. Our productive grasses all have a peak production and quality period in mid-May to late May as shown in Illustration 2.

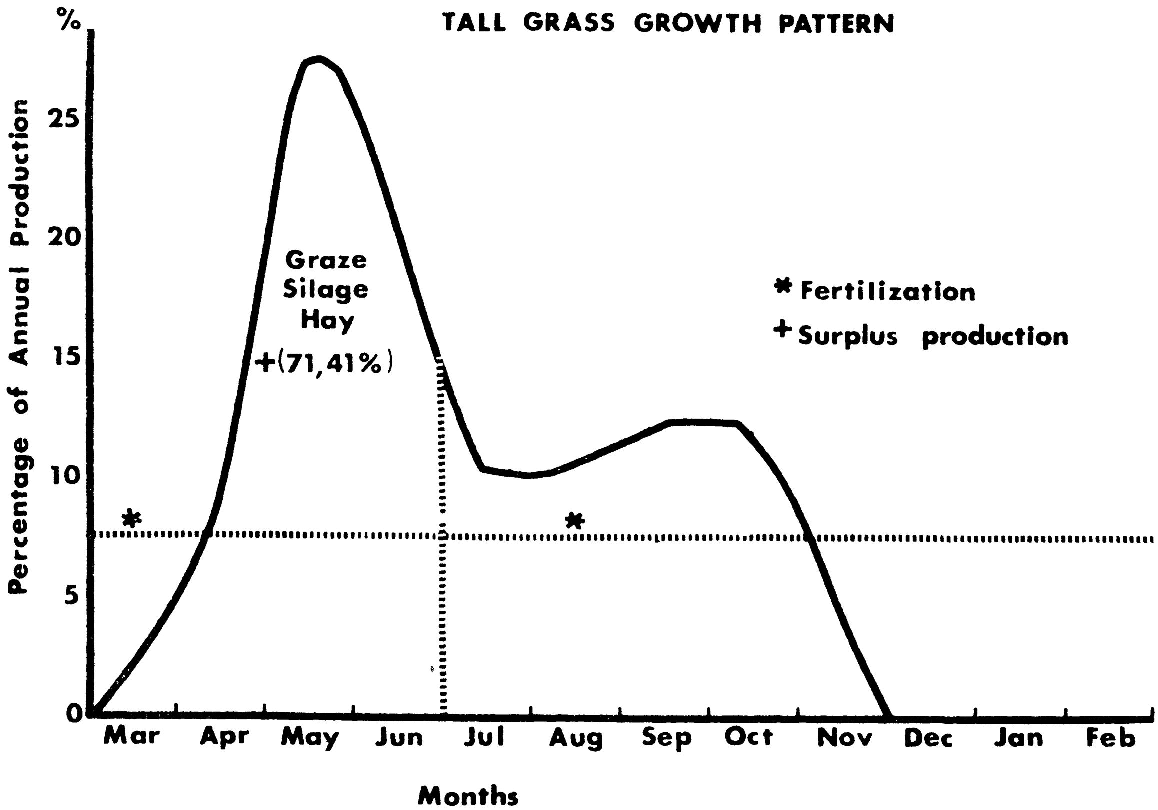


Illustration 2. Growth pattern of forages showing the surplus production during the early season. 1/

Weather uncertainties and the high moisture content of the forage at this time of the year are real obstacles, but operational plans to harvest this surplus forage at its high quality stage is essential for maximum profit.

TRENDS IN HAY MAKING 2/

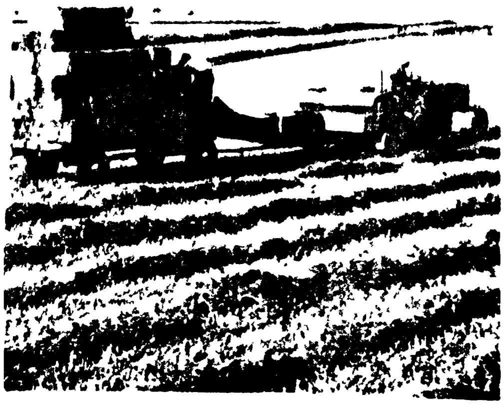
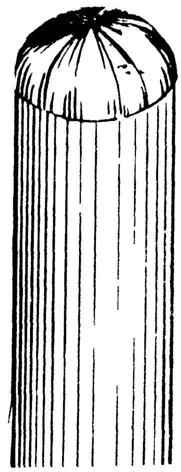
"Baling currently accounts for nearly 80 percent of the total hay harvested. Although baling has decreased slightly over the past few years, and is expected to continue to decrease slowly, it will be the dominant methods of hay harvesting through 1980.

"The haylage route and other more mechanical methods are being brought about by the shortage of dependable labor and increasing labor costs. The one machine that has helped reduce labor costs significantly by combining several operations is the mower-conditioner which cuts, conditions and windrows the forage in a single operation. The mower-conditioner was first sold in quantity in 1965.

"The introduction of the bale ejector in the mid-fifties was a major step in the mechanization of bale handling. In a recent effort to eliminate the hand labor required in haying and minimize the damage of weather, the round baler is making a fast comeback. In addition to the Allis-Chalmers round baler, two other manufacturers, Verneer of Pella, Iowa, and Hawk Bilt of Vinton, Iowa have announced the development of machines to produce large round bales ranging in weight from approximately 1,000 to 3,000 pounds.

"Haylage production can be completely mechanized from field to feeding and is expected to double in the next ten years. Cubing of hay accounts for 20% of alfalfa in Western States and is expected to triple by 1980.

"Two silage crops the same year from the same acreage offers promise in many areas. Corn silage removed, seeding the ground to wheat or other small grain crop, harvest it as wheat or grain head silage and back to a short season corn variety for another corn silage crop."


Brief Comparison of the

HAY - HAYLAGE - CORN SILAGE - ROUND BALE FORAGE SYSTEMS:

Regardless of the system followed it is important to realize that the quality of feed will not exceed the quality of forage introduced into the system, so one of the first requirements is to start with good forage. The forage should be supplemented with the required nutrients in which it is deficient.

Equipment and facilities should be considered as an aid to good management and not a substitute for it. To invest in a workable system and then not use it properly is like buying a tractor and then hooking up a team of horses to pull it.

The goal of any forage system is to provide high quality feed at a minimal cost. By coordinating the several operations of growing, harvesting, storing and feeding, the achievement of this goal is more readily assured.

Harvest and Storage Losses

"Each forage system requires a different amount of time for field curing and consequently a different degree of exposure to the elements.

Exposure time affects the amount of field loss--long exposure increases the chance of damage due to unfavorable weather, and short exposure decreases it. Also, exposure time influences moisture loss; and as the moisture level of forage decreases, losses in the field increase and storage losses decrease. Thus, combined harvest and storage losses provide a total loss for each forage system to the point of removal from storage as shown in Table 1." The round bale system was not included in this research, however assume it would compare with field-cured hay with slightly more total losses.

Table 1. Average Dry Matter Losses

System	Moisture at Storage Time	Harvest Losses	Storage Losses	Total Losses
	(Percent)	(Percent of Dry Matter)		
Hay (field-cured)	20	23	5	28
Haylage	50	9	7	16
Corn Silage	74	4	11	15

Source: Extension Bulletin 210, University of Maryland and USDA, 1966. 3/

Table 2. Total Amount of Protein and Energy Per Acre Removed from Storage*

Forage System	Lbs. Material as Fed-Out	Lbs. Crude Protein	Therms Energy (ENE)
Hay (field-cured)	5,060	794	2,090
Haylage	10,552	971	2,438
Corn Silage	22,250	490	3,293

* Based on the amount of dry matter removed from storage as shown in Table 2. Protein and energy values are based on University of Maryland Forage Evaluation Program data. 3/

Field yields in Table 2 were 3 tons of field cured alfalfa hay delivered to storage, 5.6 tons of 50% haylage, and 12.5 tons of corn silage. The amount of forage fed out was 2.53 tons of hay, 2.93 tons of hay equivalent of haylage and 11.1 tons of corn silage.

Alfalfa haylage saved more protein and energy per acre than field-cured alfalfa hay. Although corn silage produced the lowest amount of protein per acre, but it gave the highest yield of energy per acre. Corn silage produced 3,293 therms of net energy as compared with 2,438 therms for haylage and 2,090 therms for field-cured hay.

Labor Requirements

The total labor requirements from production through storage for each forage system was determined by time and motion studies made on Maryland farms. Although data were obtained over a wide range of conditions, only the systems most common in Maryland are compared in Table 3.

Table 3. Labor Requirements for Forage Systems (Including Plowing, Land Preparation, Seeding, Harvesting and Storing)*

System	Pre-Harvest	Harvesting and Storing	Total
	(Man Hours Per Acre)		
Baled Hay (Alfalfa Field-Cured)			
Baler with trailing wagon	0.8	4.8	5.6
Baler with thrower	0.8	3.9	4.7
Haylage (Alfalfa)	0.8	3.6	4.4
Corn Silage			
One Row Chopper	2.0	2.1	4.1
Two Row Chopper	2.0	1.7	3.7

* Data based on following conditions: (1) Three cuttings of hay, yielding 3 tons at 20 percent moisture; (2) three cuttings of haylage, yielding 5.6 tons at 50 percent moisture; (3) corn silage yields 12.5 tons per acre at 74 percent moisture; (4) haul to storage is 1/2 mile; (5) self-unloading wagons used for haylage and corn silage; and (6) hay and haylage are made from alfalfa. 3/

All data are for three cuttings of hay and haylage and are based on typical conditions as specified in Table 3. The labor for haylage was about the same as the baled-hay system for bale thrower, and both were lower than the baler with trailing wagon. Haylage required 4.4 man hours per acre; hay baling with bale thrower required 4.7 man hours; and baler with trailing wagon, 5.6 man hours per acre. Corn silage with one-row chopper required 4.1 hours, while with the two-row chopper it required 3., man hours. Based on three or more cuttings per season, the hay and haylage systems require more labor than does corn silage.

Corn silage takes less labor per ton of dry matter in the feeding process than the hay or haylage system as you can see in Table 4.

Table 4. Hours of Labor Per Ton to Feed Different Forage (On A Dry Matter Basis)

Method of Feeding & Type of Storage	Hours of Labor Per Ton D. M. Basis
Baled Hay	1.17
Haylage	1.08
Corn Silage (with top unloader)	.97

Source: Suter, Robert C., Forage Crops, Feeding, Progress Report 220 Purdue University. 4/

When you convert the labor requirements as listed in Table 3, to a dry matter basis and from an acre basis to a ton basis, and then add information in Table 4 you approximate the labor input of harvest through feeding as outlined in Table 5.

Table 5. Estimated Labor Requirements Per Dry Matter Ton for Different Forages (Harvesting Through Feeding)

Method of Harvesting and Feeding	Hours Per Ton (DM) Required Harvest Through Feeding
Baled Hay (Hand Fed)	
--Baler with trailing wagon	3.94
--Baler with thrower	3.49
Haylage (Mechanically Fed)	4.08
Corn Silage (Mechanically Fed)	
--One Row Chopper	2.20
--Two Row Chopper	2.08

When labor comparisons are made on a dry matter basis, the requirements per ton using the various systems are more nearly equal. Labor tends to be a variable resource and labor requirements per ton tend to be linear. That is that the hundreth ton of forage requires as much labor as does the first or the tenth ton of feed. This is not true with capital invested in machinery and facilities.

Capital tends to be a lumpy input; its costs tend to be fixed as we have indicated earlier. The amount of capital invested per ton at first tends to be high; it then declines as more and more forage is fed. Low fixed costs is a function of use. Feeding facilities should be used over 200-240 days a year at least to minimize the fixed cost per ton.

Fixed Cost of Equipment and Storage

The fixed cost of harvesting equipment and storage facilities was a major factor affecting the results of the Maryland study. This was especially true for cost of storage structure. Fixed cost, or the DIRTI-5 as used here, includes depreciation, interest, repairs, taxes and insurance.

Field-cured hay had substantially lower equipment and storage cost than any of the other systems (note Table 6).

Despite the high nutrient losses expected with field-cured hay, its comparatively low harvesting and storage cost gives the system a high rating. The initial investment in storage space in the Maryland study in 1966 was $75 per acre for hay, (3 ton yield, 20 percent moisture); $185 per acre for corn silage (12.5 ton yield); $155 per acre for haylage stored in concrete-stave silo and $298 per acre for haylage stored in gas-tight silo (based on 5.6 tons of 50-percent-moisture haylage per acre). The relatively high fixed cost of the gas-tight silo is very evident; however, if the silos can be filled 2-2½ times per year costs decrease decidedly.

Most of the difference between systems is explained by the wide range in investment requirements for stroage. Also, equipment for haylage and corn silage was much higher than for field-cured hay, due to the cost of self-unloading wagons which were not used in the hay system. Building costs are higher in 1972, although as referred to earlier hay storage can be constructed now for initial investment of $15-$20 per ton.

Table 6. Annual Fixed Cost Per Acre of Harvesting Equipment and Storage Facilities*

Items	Alfalfa Hay (Field-Cured)	Alfalfa Haylage Gas-Tight Silo	Alfalfa Haylage Concrete-Stave-Silo	Corn Silage
	- - - - - - - 50 Acres Forage - - - - -			
Harvesting Equipment (DIRTI)**	$22	$38	$38	$30
Storage Structure (DIRTI)	9	36	19	22
Totals	$31	$74	$57	$52
	- - - - - 100 Acres Forage - - - - -			
Harvesting Equipment (DIRTI)	$11	$19	$19	$15
Storage Structure (DIRTI)	9	36	19	22
Totals	$20	$55	$38	$37

* Silo cost includes unloader; storage space requirements were based on 3 tons of 20 percent hay per acre, 5.6 tons of 50 percent haylage and 12.5 tons of corn silage; self-unloading wagons were used for haylage and corn silage, farm wagons for hay. All structures and equipment cost based on 1965 new price. 3/

** DIRTI is depreciation, interest, repairs, taxes and insurance.

The combined fixed and variable cost for each system is shown in Table 7. Fixed costs of tractors, plows and other tillage equipment were not included. These items are found on all farms regardless of crops grown. It would make all cost data higher by about the same amount and would not change the relative position of any system.

Table 7. Combined Fixed and Variable Cost Per Acre of Forage Systems a/

System	Equipment, Storage, Cash Production and Harvesting Costs	
	50 Acres	100 Acres
	(Annual Cost Per Acre)	
Baled Hay (Alfalfa field-cured)b/ (Trailing Wagon)	$72	$61
Alfalfa Haylage c/		
Gas-tight silo	114	95
Concrete-stave silo with unloader	97	78
Corn Silage d/ (One-Row Chopper)	82	66

a/ All machinery depreciated at 12.5% rate (8 yrs.); storage facilities depreciated at 4% rate (25 yrs.) and interest charge was 6 percent. All data rounded to nearest dollar.
b/ Stored in pole structure; cash production cost based on alfalfa hay (3 yrs. stand).
c/ Based on alfalfa (3 yr. stand).
d/ Stored in concrete-stave silo with unloader. 3/

Chopped Hay vs. Baled Hay

The cost of storing chopped and baled hay were similar on 47 farms studied in Ohio in 1960, but the labor and equipment costs were higher for feeding the chopped hay than for the baled hay. 5/

Round Bale System

Let us send up the flag for the round bale possibilities. Some excellent research has been conducted by R. W. Van Keuren, Charles Parker 1/ and others with the research program in Ohio that adds another dimension to the forage program. Round bales that are stored in the field for consumption not only save the labor of hauling, storing and feeding, but save the labor of leading and hauling the manure to the field. Very interesting results were shown by Dr. Van Keuren's research where two beef cow herds were hauled differently the winter of 1968-69, one herd was handled conventionally by feeding near or in the barn, while the other herd was handled in the field. Labor requirements were measured on both herds from the time the hay was mowed until the manure was hauled back to the field, including the time spent building electric fences for controlled grazing, observing and assisting cows at calving. 108 hours or 4 hours per cow were required for the herd on the round bale program while 432 hours were required with the barn-managed group.

Now a sheep man could say, "Yea" but that was with cattle, but sheep like round bales, too. If it saved that much time with beef cows and "Time Saved Means Profit', logically it can save considerable time for sheep men. You can't afford to buy a new round baler for 20 acres, but with some improvising round bales will haul and store, or you can exchange baler use with your neighbor, or have it custom hired to plan the round bale program partially or totally into your forage system.

Note page 27 illustration 3 which gives the estimated availability of forage for grazing from different forage crops. 6/ It also shows how the round bale program with addition of L*N*P*K (lime, nitrogen, phosphate and potash) to fescue forage can mean 218 animal units of pasture days per acre during November through March.

Also note page 28 illustration 4 which gives examples of sheep management programs with lambing scheduled in different months taking advantage of the round bales in minimizing the total labor requirements and helping to distribute the peak labor periods over a wider span of time.

SUMMARY

The most economical forage harvesting, storage and feeding system is the one that will help you get the maximum amount of product produced per man, while intensifying the use of your machinery and building investments resulting in the greatest net profit. The first step is to analyze your resources and plan accordingly. All the so-called new progressive machinery and buildings may not spell profit on your farm. Test them by budgeting to see if the increased volume of production or the reduced labor costs will pay for the annual cost of ownership.

Do those things first that will increase your profits with very little additional investments:

1. Intensify the use of your present buildings and machinery. This also goes for the use of your land resources--this can be done by applying adequate amounts of lime and fertilizer and by seeding the highest productive grasses and legumes adapted to your area.

2. Harvest as near the peak quality period of your forages as possible to insure the maximum amount of T.D.N. per acre.

3. Expand your labor productivity by planning the hay storage and feeding to minimize the number of feeding periods per week and group ewes to have more than one lambing period to maximize the use of your labor and facilities. Total labor might be reduced by winter pasturing with the use of round bales if a custom round bale operator is in the neighborhood.

4. The above recommendations are predicted on the proposition that you are willing to expand your livestock numbers. If you can't secure ewes for example, that will produce more than 120% lamb crop to market you had better sell your hay. Note sheep budget on page 24 however your costs may be lower or higher.

The economic appraisal of the Maryland forage systems, that was discussed in this report was based on the net value of nutrients saved per acre by each system. Net value of nutrients was determined by deducting the system cost from the relative value of nutrients saved based on amounts removed from storage. The net values are summarized in Table 8. This study was conducted in 1966; so costs would be higher now, but the outcome of the same study run today would be similar.

Table 8. Cost of Systems and Net Value of Nutrients Saved by Each System When Shelled Corn is Priced at $60 Per Ton and 44% SBOM at $100 Per Ton. 3/

Items	Cost Per Acre			
	Alfalfa Hay (Field Cured)	Alfalfa Haylage		Corn Silage
		Gas-Tight Silo	Concrete-Stave Silo	
	- - - - - 50 Acres Forage - - - - -			
Value of Nutrients Saved Per Acre	$101	$117	$117	$123
Less Cost of Systems	72	114	97	82
Net Value Per Acre	$ 29	$ 3	$ 20	$ 41
	- - - - 100 Acres Forage - - - - -			
Value of Nutrients Saved Per Acre	$101	$117	$117	$123
Less Cost of Systems	61	95	78	66
Net Value Per Acre	$ 40	$ 22	$ 39	$ 57

The corn silage system produced the highest net value of nutrients per acre by a substantial amount. Field-cured alfalfa hay was second-highest in net value and alfalfa haylage was lowest.

As can be seen from table 8, for approximately 50 acres of forage the net value of nutrients from corn silage was about $41 per acre as compared with $29 for hay, $20 for haylage stored in concrete-stave silo, and about $3 per acre for haylage stored in the gas-tight silo. For a 100-acre operation, corn silage had a net value of $57 per acre as compared with $40 for hay, $39 for haylage in concrete-stave silo, and $22 per acre for haylage in the gas-tight silo. These values are based on corn priced at $60 per ton (or $1.68 per bushel) and soybean meal at $100.

"Maximum use of corn silage on the most productive cropland resulted in the lowest feed cost in a forage dairy cattle study in Michigan in 1972. Feed costs were minimized for the farm with less productive cropland by growing and feeding a forage ration with only 30 percent of dry matter from corn silage. Thus, on the less productive and often more rolling cropland, alfalfa would become a much more important forage crop." 7/

For most Ohio sheep men the baled hay route will be the most economical coupled with a winter grazing program utilizing round bales if a round baler is available for custom hire or if your volume of use will justify the ownership of a round baler.

Haylage is an excellent feed and can be profitably worked into forage program if volume of silage use will warrant the cost of silage facilities and equipment and only budgeting on an individual farm basis would answer this question.

Corn silage route will return the greatest T.D.N. per acre on corn eligible ground, but if new investments in harvesting, storage and feeding systems have to be made to take advantage of corn silage, this would not be a profitable route to follow unless you had well over 600 productive ewes or other kind of livestock that could profit from a silage program. However, if silage storage is already available and custom harvesting is available this route should have a high priority for all or part of the forage program.

If you have continuous corn ground and your livestock operation is large enough to justify the silage route, it is conceivable that you can reduce the total acreage required for roughage eating animals 30 to 40% over the hay route. The big question is how large do you have to be? That varies by every farm depending on where it is now as far as present machinery and facilities, and the custom hire options. However, if you are starting from zero (no buildings or equipment) you had better have a place for over 800 tons of silage to productive ruminants. Even then alternative uses of your money should be analyzed and your planning horizon clearly in mind.

There must be change if there is to be growth in any industry. The wise farm businessman recognizes the trends early, evaluates their impact on his individual farm and takes action to capitalize on the trend.

"Experience teaches that men are so much governed by what they are accustomed to see and practice, that the simplest and most obvious improvements in the most ordinary occupations are adapted with hesitation, reluctance and by slow graduations." Alexander Hamilton, 1791.

"MANY WAYS TO FIGURE EWE PROFITS - DEPENDS ON THE COSTS YOU CONSIDER"

FOLLOWING ARE TWO COMMON METHODS OF FIGURING COSTS AT TWO DIFFERENT LAMBING LEVELS

	Profit Above Total Costs (Fixed & Variable)		Profit Above Variable or Cash Costs	
Variable Costs Per Ewe*	120% Lambing	180% Lambing	120% Lambing	180% Lambing
Feed (one-half)	$ 9.00	$ 9.75	$ 9.00	$ 9.75
Interest, 8% on livestock & operating capital	2.10	2.10	2.10	2.10
Misc., Electric & supplies	.65	.65	.65	.65
Vet., Med. & Dipping	.60	.60	.60	.60
Shearing	.90	.90	.90	.90
Breeding or Ram Charge 1/	.50	.50	.50	.50
Ewe Depreciation 2/	6.00	6.00	6.00	6.00
Variable Costs	$19.75	$20.50	$19.75	$20.50
Fixed Costs Per Ewe				
Feed (one-half)	$ 9.00	$ 9.75	(No Charge For Fixed Costs)	
Labor (4 & 5 hours)	10.00	12.50		
Building & Equipment - 14%	5.05	5.05		
Fixed Costs	$24.05	$27.30	___	___
Total Costs	$43.80	$47.80	$19.75	$20.50
Returns Per Ewe 3/				
95 Pound Lamb @ $27.00	$30.78	$46.17	$30.78	$46.17
@ $31.00	35.34	53.01	35.34	53.01
Wool 10 Pounds @$ .72	7.20	7.20	7.20	7.20
Net Returns Per Ewe @ $27.00	-5.82	+5.57	+18.23	+32.78
@ $31.00	-1.26	+12.41	+22.79	+39.71

*Assuming one-half feed purchased in kind or cost to produce same and that no hired labor needed (family labor charged at $2.50 per hour).

1/ Ram cost $60; salvage value $15; three years life; 30 ewes per ram

2/ Ewe cost $35; salvage value $5; five year life

3/ Returns are after marketing charges and death losses have been deducted. Credit to wool incentive payments included in the returns.

← Correct error in Sec. III F 1 in Net Returns from -1.40 to +1.40

BUDGETED ANNUAL FIXED OVERHEAD COSTS ON NEW MACHINERY, EQUIPMENT AND BUILDINGS

	Average Over Entire Lifetime (Mid-Value) % Of New Cost	Example Column	My Farm Dollars
Field Equipment		$10,000 Tractor	
D - depreciation - 8 years	12.5%	$ 1,250	$______
I - interest - 8% of average value	4.0%	400	$______
R - repairs	2.5%	250	$______
T - taxes*	0.1%	10	$______
I - insurance	0.2%	20	$______
H - housing	0.7%	70	$______
Total	20.0%	Ave. Annual Cost $ 2,000	$______
Livestock Equipment		$ 2,000 Silo Unloader	
D - depreciation - 8 years	12.5%	250	$______
I - interest - 8% of average value	4.0%	80	$______
R - repairs	2.2%	44	$______
T - taxes*	0.1%	2	$______
I - insurance	0.2%	4	$______
Total	19.0%	Ave. Annual Cost $ 380	$______
Farm Buildings		$ 8,000 Barn	
D - depreciation - 10 years	10.0%	$ 800	$______
I - interest - 8% of average value	4.0%	320	$______
R - repairs	1.2%	96	$______
T - taxes	0.6%	48	$______
I - insurance	0.2%	16	$______
Total	16.0%	Ave. Annual Cost $ 1,280	$______

* After 1972 personal property taxes on machinery and equipment will be discontinued.

EXAMPLE:

*TESTING YOUR BUYING
FOR
INCREASED INCOME

(Partial Budget)

Adjustment to be made POSSIBILITY OF PURCHASING A $2,800 "ROUND BALER" TO BE USED ON 30 ACRES OF HAY OR 3,000 BALES.

"LOSSES" (-)	"GAINS" (+)
**Added Expenses	Added Income
ANNUAL FIXED COST - $560 (DIRTI-5) $\frac{\$560}{30}$ = $18.66 COST PER ACRE $\frac{\$560}{3,000}$ = 19¢ PER BALE VARIABLE COST - $120 $4 PER ACRE OR 4¢ PER BALE	NONE (IF CUSTOM HIRE WAS NEEDED IN THE COMMUNITY, THIS MIGHT BE A POSSIBILITY FOR ADDED INCOME)
Reduced Income	**Reduced Expenses
NONE	CUSTOM BALING "BILL" = $450 "HAVE BEEN HAVING HAY CUSTOM BALED." 3,000 BALES X 15¢ EACH
- Total $ 680	+ Total $ 450

(+) "GAINS" $ 450 minus (-) "LOSSES" $ -680 = NET CHANGE $ -230
(+ or -)

*Calculate costs and returns on an annual basis.
**Include depreciation, interest, repairs, taxes, insurance, and storage.

Consider risk, other alternative uses for your money, etc.

Illustration 3

ESTIMATED AVAILABILITY OF FORAGE FOR GRAZING EXPRESSED BY MONTHS IN ANIMAL UNITS PER ACRE AVAILABLE[a]

Crop	Total Average Pasture Days Per Acre-Per Year	Animal Unit Grazing Days/Acre											
		A	M	J	J	A	S	O	N	D	J	F	M
Alfalfa mixture													
No hay removed	143	3	28	32	34	12	18	12	4				
Alfalfa mixture													
After June hay	69				14	20	19	12	4				
Birdsfoot trefoil	87		12	32	22	14	7						
Bluegrass (untreated)	43		12	14	3	2	5	5	2				
Bluegrass L (60N) P-K	134	20	44	34	7	3	11	11	4				
Bromegrass L-N-P-K	137	3	35	34	12	10	16	18	9				
Clover-Timothy	99	3	26	26	14	7	11	9	3				
Clover-Timothy													
After June hay	47				8	16	12	8	3				
Fescue L-N-P-K	242	28	48	46	12	10	20	28	25	15	10		
Fescue (round bales)[b]													
L-N-P-K	218								30	60	60	56	12
Orchard grass L-N-P-K	181	15	43	43	25	20	15	15	5				
Sudan	120			42	42	47	20	17					
Corn stalks	60								30	20	10		

[a]From summary of primary data from southern and southeastern branches of OARDC.

[b]Growth is baled into round bales and stockpiled in the field and the acreage divided for controlled grazing.

Source: White, Bennie Lee, Thesis, An Economic Comparison of Beef Cow-Calf Feeding Systems in Southern Ohio, The Ohio State University, 1969.

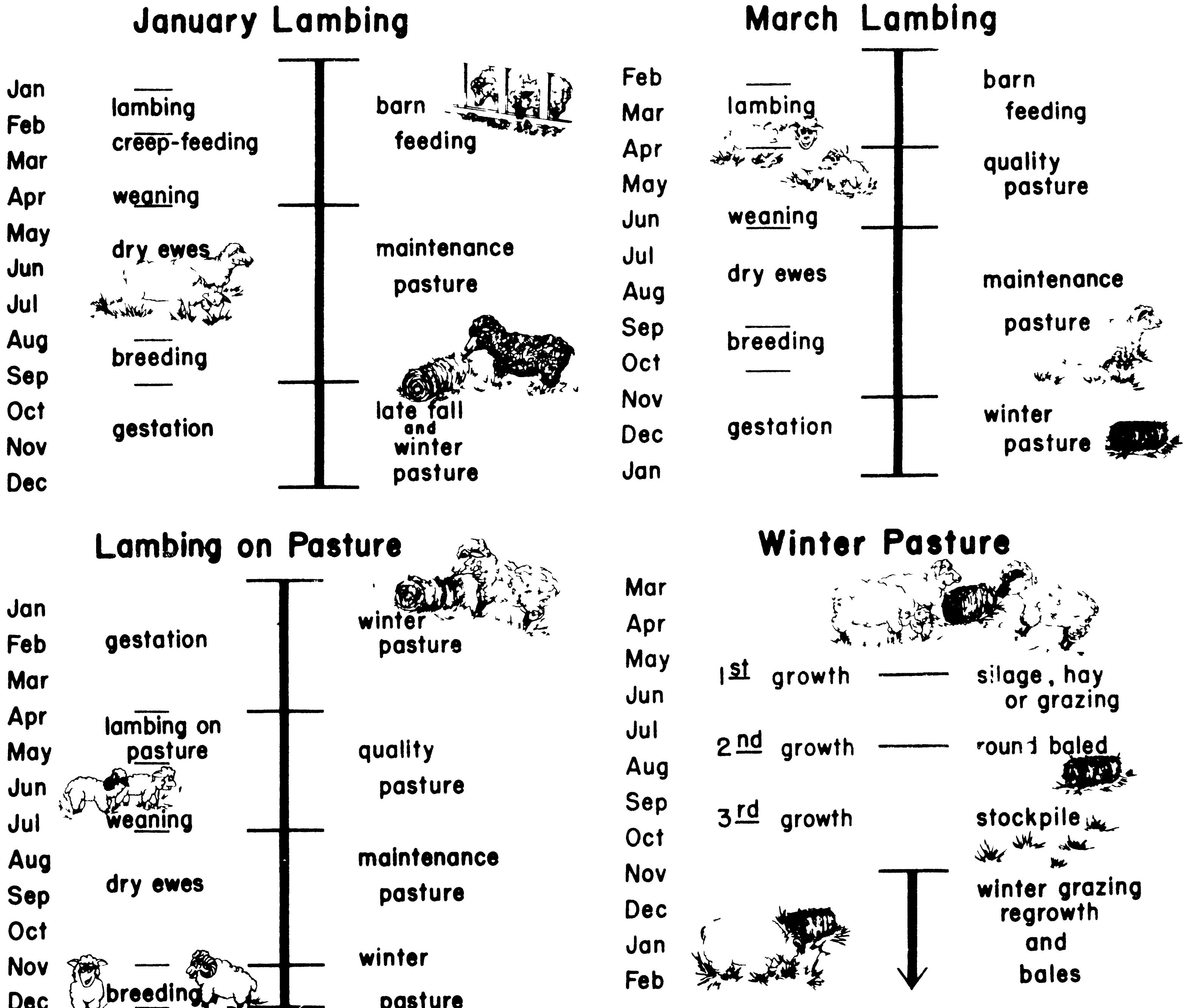


Illustration 4. Outline of forage systems for January lambing, March lambing, lambing on pasture, and winter pasture.

SOURCE: Van Keuren, R. W., Forage Systems For Sheep, O.A.R.D.C., Research Summary 53, 1971.

Illustration 5. Investment Cost Per Ton of Storage Including Unloader, Permanent Fill Pipe, Foundation and Wiring.

Size (ft.)	Approximate Capacity (tons)[a]	Total Investment Cost		Investment Cost Per Ton Stored	
		Vertical Silos			
		Concrete	Airtight	Concrete	Airtight
16 x 40	177	$ 4,850	--	$27.40	--
16 x 50	238	5,400	--	22.69	--
18 x 50	302	5,900	--	19.54	--
18 x 60	387	6,700	--	17.31	--
20 x 50	373	6,500	$ 16,500	17.43	$44.24
20 x 60	478	7,400	18,500	15.48	38.70
20 x 70	580	8,400	19,700	14.48	33.97
24 x 60	689	9,400	--	13.64	--
24 x 70	852	10,500	--	12.32	--
24 x 75	930	11,300	--	12.15	--
25 x 65	840	--	29,800	--	35.48
25 x 80	1,100	--	32,700	--	29.73
		Horizontal Silos[b]			
20 x 50	200[c]	1,500	--	7.50	--
30 x 60	400[c]	2,400	--	6.00	--
30 x 80	500[c]	3,000	--	6.00	--
40 x 90	800[c]	4,300	--	5.38	--
50 x 100	1,000[c]	4,900	--	4.90	--
60 x 120	1,500[c]	6,900	--	4.60	--

a/ 70 percent moisture corn silage.
b/ Investment cost estimated for below-ground silo, no unloader.
c/ Based on average silage density of 35 pounds per cubic foot, and average depth of 12 feet.

Source: Pm-535, 1972 Harvesting, Storing, and Processing Feeds for Beef Cattle, Iowa State University, Ames, Iowa.

Bibliography

1. Van Keuren, R.W., Parker, C.F., Department of Agronomy and Animal Science, O.A.R.D.C., Wooster, Ohio.

2. Shindelar, JoJo, Harvest Mechanization Trends Proceedings Fifth Research Industry Conference, January, 1972, Louisville, Kentucky.

3. A Comparison of Forage Handling Systems, Extension Bulletin 210, 1966. Prepared by Stevens, George, Stewart, Larry, and Cason, James, Department of Agricultural Economics, Agricultural Engineering and Dairy Science, University of Maryland.

4. Suter, Robert C., Professor Agricultural Economics Department, Purdue University, Forage Crops: Feeding Progress Report 220, Purdue University.

5. Shaudys, E.T., Sitterly, J.H., and Moore, C.V., Cost of Storing and Feeding Chopped and Baled Hay, Research Bulletin 854, July, 1960, The Ohio State University.

6. White, Bennie Lee, Thesis, "An Economic Comparison of Beef Cow-Calf Feeding Systems in Southern Ohio," The Ohio State University, 1969.

7. Hoglund, C.R., Schwab, G.D., and Tesar, M.B., Economics of Growing and Feeding Alfalfa and Corn Silage for Dairy Cattle, Research Report 154, Michigan State University Agricultural Experiment Station, East Lansing, Michigan, 1972.

8. Ewing, S.A., Harvesting, Storing and Processing Feeds for Beef Cattle, 1972, Iowa State University Experiment Station, Ames, Iowa, Pm535.